

an activated p-type growth layer comprising gallium nitride and an acceptor dopant material formed without the use of a post-growth activation step.

16. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (0001) silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium arsenide, (100) gallium arsenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer having a thickness of about 30 Å to about 500 Å grown on the substrate and comprising a first material consisting essentially of a Group III nitride grown at a temperature of about 100° C. to about 400° C. from a molecular Group III source and an activated nitrogen source in a molecular beam epitaxial growth chamber; and

a first growth layer grown on the buffer layer and comprising gallium nitride and a first dopant material, the first growth layer being grown at a temperature of at least about 600° C. from a molecular gallium source and an activated nitrogen source in a molecular beam epitaxial growth chamber.

17. The semiconductor device of claim 16 wherein the Group III nitride is gallium nitride.

18. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium arsenide, (100) gallium arsenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer having a first thickness, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride; and

a growth layer grown on the buffer layer having a second thickness which is at least ten times greater than the first thickness, the growth layer comprising gallium nitride and a first dopant material.

19. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111)

silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium arsenide, (100) gallium arsenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride; and

a growth layer grown on the buffer layer, the growth layer comprising gallium nitride and a first dopant material.

20. A semiconductor device having an activated p-type layer comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium arsenide, (100) gallium arsenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a material grown on said substrate, the material consisting essentially of gallium nitride; and

an activated p-type growth layer comprising gallium nitride and a dopant material formed without the use of a post-growth activation step.

21. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium arsenide, (100) gallium arsenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer grown on the substrate and comprising a material consisting essentially of a Group III nitride grown at a temperature of about 100° C. to about 400° C. from a molecular Group III source and an activated nitrogen source in a molecular beam epitaxial growth chamber; and

a growth layer grown on the buffer layer and comprising gallium nitride and a first dopant material, the growth layer being grown at a temperature of at least about 600° C. from a molecular gallium source and an activated nitrogen source in a molecular beam epitaxial growth chamber.

* * * * *